Fisheries Session

Orangemouth Corvina and Orangemouth Corvina x Spotted Seatrout Hybrids in a Freshwater Reservoir

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Abstract: Post-stocking survival, biomass, food habits, growth, and angler utilization of orangemouth corvina (*Cynoscion xanthulus*) (OMC), ♀ spotted seatrout (*C. nebulosus*) (SST) X ♂ OMC hybrids, and ♀ OMC X ♂ SST hybrids were monitored from 1986 to 1990 at Calaveras Reservoir, a south Texas urban impoundment, after introductions from 1984 to 1986. Survival was excellent for all introduced fishes. Peak catch per unit effort by gill nets coincided with peak biomass estimates determined from cove rotenone sampling in 1987. Although similarly dense populations of blue tilapia (*Tilapia aurea*) and shad (*Dorosoma* spp.) existed in the reservoir, OMC and hybrids fed exclusively on the shad. Growth rates based on known age and length at capture fitted to a von Bertalanffy growth model indicated both hybrids had faster growth than OMC; growth was rapid for all 3. Corvina grew to 46 cm TL in 1.5 years; the reservoir record was 5.81 kg. During the fishing peak, corvina harvest rates at Calaveras Reservoir were generally higher than Texas statewide averages for largemouth bass (*Micropterus salmoides*) and channel catfish (*Ictalurus punctatus*), and much greater than rates reported for OMC in the Salton Sea, California.

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Orangemouth corvina (OMC) provide a substantial sport fishery in the Salton Sea, a landlocked saltwater lake in southern California. There, OMC complete their life cycle in a high salinity environment, feed on tilapia (*Tilapia* spp.), an often undesirable exotic fish in many Texas reservoirs, and grow to approximately 16 kg (Whitney 1961; Black 1974, 1985; Collins 1981). Further, OMC were found to tolerate extremely low salinities (Prentice 1985). Thus they exhibited potential as a sport and predator fish for Texas power-plant reservoirs.

OMC spawning (Prentice and Colura 1984, Prentice and Thomas 1987, Prentice et al. 1989) and culture techniques (Maciorowski et al. 1986) were developed that provided young for stocking. Additionally, viable hybrid offspring were produced by crossing ♂ OMC with ♀ SST and ♂ SST with ♀ OMC (Maciorowski et al. 1986, Procarione et al. 1988). These fish were introduced into Calaveras Reservoir as a sport fish and predator on tilapia. This study reports post-stocking survival, food habits, and growth and angler utilization of OMC and hybrids between OMC and SST in Calaveras Reservoir.

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Methods

Calaveras Reservoir, impounded in 1969 and covering 1,397 ha, is located 24 km southeast of San Antonio, Bexar County, Texas. It provides cooling water for a coal-burning power plant and has a mean depth of 5.5 m and a maximum depth of 13.7 m. Reservoir water level is maintained relatively constant by pumping water from the San Antonio River. Bottom-water temperatures range from approximately 9.0° to 31.5° C annually. Basic water quality is described by the following parameter means ($\pm$SD, N = 10; 1983–1985): pH = 8.8 ± 0.14; total alkalinity = 212.4 ± 16.95 ppm as $CaCO_3$; sulfate = 114.2 ± 12.15 ppm; chloride = 109.4 ± 60.38 ppm; and specific conductance = 915.0 ± 156.00 μmhos/cm^2.

Fingerling OMC, ♀ SST X ♂ OMC hybrids, and ♀ OMC X ♂ SST reciprocal hybrids were produced at the Perry R. Bass Marine Fisheries Research Station, Palacios, Texas, and stocked into Calaveras Reservoir from 1984 to 1986 (Table 1). Reproduction by OMC or OMC hybrids in Calaveras Reservoir was assumed impossible because Howells (1990) found no survival of OMC fertilized eggs at salinities below 5.5 ppt. Through August 1988 there was a 5-fish/day bag and 45.7 cm TL limit on all corvina, but no regulation thereafter.

Post-stocking survival, abundance, and food habits of corvina were determined from variable mesh size gill net data collected from 1984 to 1990 as described by TPWD (1989). Total length (TL, mm) and weight (g) of each corvina collected were recorded allowing identification of year classes. Stomach contents were removed, identified, and counted from 20 OMC and 44 hybrids to determine food habits.

Biomass estimates were calculated from cove rotenone data collected according to TPWD (1989). Three coves totaling 1.21 ha were sampled in July (1983–1984, 1986–1990).

Corvina growth was determined by fitting mean length-at-age and known age (months) data to the von Bertalanffy growth model: $L_t = L_{inf}(1\text{-exp}[-K\{t - t_o\}]$, where L_{inf} is asymptotic TL, K is the growth coefficient, t_o is age at zero length, and L_t is TL (mm) at age t (years). The von Bertalanffy model was fit by unweighted nonlinear least-squares using Marquardt's algorithm (Marquardt 1963). Weight-length relationships for OMC and each hybrid, sexes combined, were calculated by simple linear regression procedures.

Table 1. Stocking history for orangemouth corvina (OMC), ♀ spotted seatrout (SST) X ♂ OMC hybrids, and ♀ OMC X ♂ SST hybrids, Calaveras Reservoir, Texas, 1984–1986.

Date	Species	*N*	Approximate size (mmTL)
Jul 1984	♀SST X ♂OMC	12,000	38
Nov 1984	♀SST X ♂OMC	2,500	38
Jun 1985	♀SST X ♂OMC	6,950	51
Aug 1985	♀SST X ♂OMC	17,600	38
May 1986	OMC	4,500	26
Jul 1986	♀OMC X ♂SST	1,550	26
Aug 1986	OMC	219,000	26
Sep 1986	OMC	543,300	28
	♀OMC X ♂SST	22,300	28

Harvest, catch, and angler acceptance of corvina were determined by creel surveys from 1986 to 1990 as described by TPWD (1989). Creel surveys were conducted on 5 weekend and 4 week days selected randomly for each quarter. Weighted least squares regression analysis (Freund and Littell 1981) was used to test for significant relationships ($P \leq 0.05$) between angler effort, fishing success, and distance traveled to fish versus creel year (Yr); angler class (anglers seeking corvina or anglers seeking any other species) was used as a covariable to test for differences ($P \leq 0.05$) in distance traveled to fish. Annual means were weighted by the inverse of variance for each mean.

Additional creel data were obtained from the San Antonio River Authority (SARA) which conducted a continuous voluntary creel survey at the only entrance to the reservoir 24 hours/day, 365 days/year from 1984 to 1990. Anglers leaving the reservoir were asked to have their fish counted and to provide information on bait type and fishing style (boat or shore).

Field identification of OMC and the 2 OMC hybrid groups was based on size and coloration patterns, i.e., presence (hybrid) or absence (OMC) of black spots on the dorsal and caudal fins. Species identification was first recognized as a problem in 1987 when OMC and ♀ OMC X ♂ SST hybrids, stocked in 1986, were collected. Spots on the dorsal and caudal fins of the hybrids faded once the fish died (Howells 1991). Because many OMC and hybrids collected with gill nets did not survive long after they became entangled, loss of coloration occurred and identification was questionable for some individuals. Therefore, determinations of survival, food habits, growth, and weight-length relationships were based only on data from positively identified individuals from gill net collections. Coloration of OMC and hybrids harvested by anglers also faded once fish were placed on a stringer or in an ice box. Standing-stock data collection by cove rotenone techniques also allowed coloration of OMC and hybrids to fade. Therefore, catch, harvest, and standing-stock data were combined for all corvina.

Results and Discussion

Post-stocking survival of OMC and hybrids was first documented by gill net recaptures 3 to 6 months after initial stockings (Table 2). Gill net CPUE was greatest for corvina in 1987 (Table 2) which coincided with peak density estimates (Table 3). The 1986 density estimate of 22 fish/ha (Table 3) suggested high stocking survival based on a total stocking of 32 fish/ha (Table 1) and/or possible corvina congregation in the reservoir cove habitats.

Only 39% of the corvina stomachs contained identifiable food items. Gizzard shad (*Dorosoma cepedianum*) and threadfin shad (*D. petenense*) composed 100% of food items found. A large percentage of empty stomachs also was found in OMC collected from the Salton Sea (Whitney 1961). In that study, threadfin shad were the third most important food item behind bairdiella (*Bairdiella icisticus*) and longjaw mudsucker (*Gillichthys mirabilis*). Salton Sea OMC apparently fed on prey species in direct proportion to their abundance in the fish community. OMC also fed on tilapia as they became abundant after introduction into the Salton Sea (Black 1974, 1985). In Calaveras Reservoir, corvina fed exclusively on shad (*Dorosoma* spp.) even though blue tilapia (*Tilapia aurea*) biomass was similar to that of shad (Table 3).

Growth of OMC and both hybrids in Calaveras Reservoir was faster than that

Table 2. Gill net collections of orangemouth corvina (OMC), ♀ spotted seatrout (SST) X ♂ OMC hybrids, and ♀ OMC X ♂ SST hybrids, Calaveras Reservoir, Texas, 1984–1990.

Date	N	Year class	Age[a] (months)	Species	Length range (mmTL)	CPUE[b]
Oct 1984	14	84	3	♀SST X ♂OMC	254–277	2.8
Jan 1985	6	84	6	♀SST X ♂OMC	323–337	1.2
Oct 1985	4	84	14	♀SST X ♂OMC	470–534	1.3
	10	85	4	♀SST X ♂OMC	290–348	3.3
Jan 1986	5	84	17	♀SST X ♂OMC	514–561	1.0
	10	85	7	♀SST X ♂OMC	313–429	3.3
Jun 1986	7	84	22	♀SST X ♂OMC	528–660	1.4
	47	85	12	♀SST X ♂OMC	362–497	9.4
Feb 1987	1	84	30	♀SST X ♂OMC	650	0.2
	12	85	20	♀SST X ♂OMC	455–575	2.4
	83	86	6	OMC	233–363	16.6
	11	86	6	♀OMC X ♂SST	215–305	2.2
May 1988	40	86	21	OMC	494–620	8.0
	4	86	21	♀OMC X ♂SST	585–618	0.8
Oct 1988	31	86	26	OMC	527–668	6.2
	2	86	26	♀OMC X ♂SST	630–654	0.4
Apr 1989	1	85	46	♀SST X ♂OMC	746	0.2
	15	86	32	OMC	479–695	3.0
	2	86	32	♀OMC X ♂SST	632–680	0.4
Apr 1990	11	86	44	OMC	665–755	2.2

[a]Age from egg hatching.
[b]CPUE = catch per unit effort (*N* of corvina/gill net set).

described for OMC in their native Gulf of California (Blake and Blake 1981) or the Salton Sea (Whitney 1961) (Table 4). Both hybrids grew faster than OMC, but all corvina grew to legal harvest size (46 cm TL) by ≤1.5 years (Table 4). Weight-length relationshps for ♀ SST X ♂ OMC hybrids, ♀ OMC X ♂ SST hybrids, and OMC, respectively, were:

1) $\log_{10}$ (weight) = −4.8866 + 2.9756 $\log_{10}$ (TL); R^2 = 0.98 for TL range 254–746 mm, N = 117,

2) $\log_{10}$ (weight) = −5.2053 + 3.0939 $\log_{10}$ (TL); R^2 = 0.98 for TL range 215–680 mm, N = 19, and

3) $\log_{10}$ (weight) = −5.3701 + 3.1526 $\log_{10}$ (TL); R^2 = 0.98 for TL range 233–755 mm, N = 180. Weight-length relationships for OMC and hybrids were similar to that reported for OMC from the Gulf of California (Warburton 1979) and indicated individuals would weigh 1,058 to 1,088 g at 46 cm TL.

The first corvina angler harvest was documented by the SARA voluntary creel when 4 fish were harvested during 1984. The SARA creel survey showed angler harvest of corvina increased each year after 1984, peaking in 1988. TPWD creel data similarly indicated rapid fishery development as estimated annual corvina harvest increased from 3,493 fish (6,733 kg) in 1986 to 20,396 fish (37,384 kg) in 1988 (Table 5). Angler effort directed at corvina increased from 0.9% to 13.0% of the total angler effort from 1986 to 1988 (Table 5). Angler effort was a quadratic function of year (Effort = −23.002 + (31.205 Yr) − (4.803 Yr^2); R^2 = 0.97, P = 0.0272), which increased from 1986 to 1988 and decreased thereafter (Table 5). There was no significant relationship (R^2 = 0.62, P = 0.3796) for success rate for anglers seeking corvina, indicating success in the same time period remained high (Table 5). Also, the fishery lasted at least 4 years after the last stockings in 1986 (Table 5). The rapid growth (Table 4) and large mean size of corvina caught (Table 6) resulted in a trophy fishery with the reservoir record in 1990 weighing 5.81 kg.

Angler catch rate was highest in 1987 (Table 6) when the density of corvina was indicated to be highest (Tables 2 and 3). The very high release rate in 1987 (Table 6) can be explained by the large number of sub-legal fish in the population (Table 2). However, reasons for the high release rate in 1989 (Table 6) are unknown. It is possible anglers voluntarily released corvina to prolong the life of the fishery in the absence of restocking.

The average distance anglers traveled to fish at Calaveras Reservoir during this study was approximately 45 km. Although 3 angler parties claimed to travel >1,100 km seeking corvina during 1988, there was no significant relationship (R^2 = 0.80, P = 0.1979) found indicating difference in distance traveled by corvina anglers over years. However, analysis of covariance indicated a significantly (P = 0.0055) greater distance traveled by anglers seeking corvina than anglers seeking other species.

The SARA voluntary creel survey indicated 75% of harvested corvina were caught with artificial lures (including primarily silver and gold spoons, green grubs, and plastic worms). Most frequently used natural baits were blue tilapia and shad, but various cyprinids, penaeid shrimp, crayfishes, earthworms, and chicken liver

Table 3. Standing stock estimates (*N* and weight, kg, per ha) of major predator and prey fishes, Calaveras Reservoir, Texas, based on cove rotenone sampling each July, 1983–1990.

	1983		1984		1986		1987		1988		1989		1990	
Species	*N*	Weight	*N*	Weight	*N*	Weight	*N*	Weight	*N*	Weight	*N*	Weight	*N*	Weight
Gizzard shad	1,898	60.7	4,907	64.7	2,453	101.6	1,201	50.5	2,871	144.4	2,892	91.5	3,729	139.1
Threadfin shad	42,780	65.9	6,555	12.2	14,570	26.8	3,950	8.2	27,077	62.4	15,377	35.6	30,974	55.3
Corvina[a]					22	39.3	46	42.0	39	75.9	27	80.3	21	71.8
Blue tilapia	30,209	155.5	8,484	202.7	7,740	302.0	15,408	253.8	11,594	449.4	23,141	558.1	33,670	653.6

[a]Orangemouth corvina (OMC), ♀ spotted seatrout (SST) X ♂ OMC hybrids, and ♀ OMC X ♂ SST hybrids combined.

Table 4. Estimates of von Bertalanffy growth model parameters and calculated lengths at age for orangemouth corvina (OMC), ♀ spotted seatrout (SST) X ♂ OMC hybrid, and ♀ OMC ♂ SST hybrids, Calaveras Reservoir, Texas, and other locations. L_∞ is the asymptotic total length (mm), K is the growth coefficient, and t_o is the age at zero length (years). NA indicates von Bertalanffy growth parameters were not calculated; lengths at age were determined by direct proportion back calculations.

		Aging		von Bertalanffy growth parameters (SE)			Calculated mean total length at age (mm)			
Location	Species	method[a]	*N*	L_∞	K	t_o	1	2	3	4
Calaveras	♀SST X ♂OMC	KA	117	1,033 (179.6)	0.29 (0.089)	−0.81 (0.146)	422	576	691	777
Calaveras	♀OMC X ♂SST	KA	19	685 (40.7)	1.28 (0.389)	0.19 (0.094)	442	617	666	
Calaveras	OMC	KA	180	809 (31.6)	0.50 (0.053)	−0.39 (0.062)	405	564	660	719
Gulf of California, Mexico[b]	OMC	S	52	NA	NA	NA	217	362	557	
Salton Sea, California[c]	OMC	S	446	NA	NA	NA	130	465	589	683

[a]KA = known age, S = Scales.
[b]From Blake and Blake (1981).
[c]From Whitney (1961).

Table 5. Summary of annual creel survey estimates comparing any species to orangemouth corvina (OMC) and OMC X spotted seatrout hybrids combined (corvina), Calaveras Reservoir, Texas, 1986–1990. Standard errors are in parentheses.

	Fishing effort (hours/ha) directed at		Harvest rate while seeking				Percent success[a] considering effort seeking	
			Any species		Corvina			
Year	Any species	Corvina	Fish/ha	kg/ha	Fish/ha	kg/ha	Any species	Corvina
1986	377.8 (41.49)	3.4 (1.08)	104.4 (14.39)	86.78 (13.79)	2.5 (0.66)	4.79 (1.11)	44.9 (2.1)	4.1 (0.9)
1987	351.1 (36.29)	17.8 (4.71)	143.8 (30.61)	67.89 (12.28)	6.7 (1.87)	8.11 (2.57)	40.6 (2.8)	26.2 (5.8)
1988	351.9 (50.64)	45.4 (8.46)	73.4 (12.59)	60.12 (11.02)	13.8 (3.01)	25.31 (5.40)	38.8 (3.1)	34.3 (7.8)
1989	262.1 (24.04)	25.0 (4.27)	48.6 (7.31)	35.00 (5.03)	3.1 (0.81)	8.31 (2.12)	36.0 (3.0)	8.2 (2.4)
1990	233.5 (24.90)	12.9 (3.38)	57.1 (8.87)	30.87 (4.44)	1.4 (0.62)	4.88 (2.17)	37.2 (4.8)	5.8 (1.4)

[a] Parties harvesting at least 1 fish/trip.

Table 6. Annual creel estimates for anglers seeking corvina, Calaveras Reservoir, Texas, 1986–1990. Corvina = orangemouth corvina (OMC) and OMC X spotted seatrout hybrids combined. Standard errors are in parentheses.

	N corvina			Mean weight of corvina	
Year	Harvest/hour	Release/hour	Total catch/hour	kg/hour	kg/fish
1986	0.175 (0.023)	0.000 (0.000)	0.175 (0.023)	0.280 (0.030)	1.599 (0.335)
1987	0.135 (0.018)	0.421 (0.054)	0.556 (0.050)	0.212 (0.031)	1.545 (0.085)
1988	0.224 (0.034)	0.012 (0.008)	0.236 (0.039)	0.401 (0.058)	1.768 (0.038)
1989	0.005 (0.001)	0.026 (0.003)	0.031 (0.002)	0.012 (0.002)	2.336 (0.068)
1990	0.129 (0.027)	0.000 (0.000)	0.129 (0.027)	0.434 (0.096)	3.629 (0.092)

were also successful. Also, SARA creel data indicated 93% of corvina were harvested by boat anglers and 7% by shore anglers.

Calaveras Reservoir supported a highly productive sport fishery with annual harvest ranging from 48.6 fish/ha (30.87 kg/ha to 143.8 fish/ha (86.78 kg/ha) (Table 5). These values are much higher than for the Texas statewide average harvest which ranged (1986–1989) from 20.6 fish/ha (13.01 kg/ha) to 37.3 fish/ha (19.64 kg/ha) (TPWD creel survey data files). Likewise, the Calaveras Reservoir corvina annual harvest (Table 5) was generally higher than the Texas statewide average harvest of 2 major sport fishes, largemouth bass and channel catfish, which ranged (1986–1989) from 2.2 fish/ha (1.98 kg/ha) to 5.2 fish/ha (3.67 kg/ha) and 4.5 fish/ha (2.39 kg/ha) to 9.5 fish/ha (3.64 kg/ha), respectively (TPWD creel survey data files).

According to Black (1985), the highest angler harvest rate found in 1 area of the Salton Sea, California, for OMC, relative to various fishes and locations in the Sea, was 0.085 fish/hour on an annual basis. With the exception of 1989, Calaveras Reservoir corvina harvest rates (Table 6) were substantially greater than those estimated for OMC at the Salton Sea, again clearly demonstrating strength of the Calaveras Reservoir corvina fishery.

OMC were brought to Texas to provide an additional predator on problematic tilapia populations found in many power-plant cooling reservoirs and to provide an additional sport species. Calaveras Reservoir was chosen as a stocking site because it was felt there was very little chance of escapement. Water level maintenance by pumping water only into the reservoir and a relatively small watershed of 168.4 km^2 made reservoir overflow, due to rainfall, and resultant accidental release of corvina highly unlikely. Although corvina adapted well and provided an exceptional fishery at Calaveras Reservoir, this study highlighted 2 reasons for concern. First, corvina did not provide predatory pressure on tilapia and, second, OMC can hybridize with SST, a major fishery species in the Gulf of Mexico. Effects of the exotic OMC or OMC X SST hybridization on natural Gulf of Mexico marine ecosystems are undesirable; consequently, the decision was made to stop stocking corvina in Texas. Similar concern and precautions should be taken anytime introduction of corvina outside its native range is considered.

Literature Cited

Black, G. F. 1974. The party boat fishery of the Salton Sea and the apparent effect of temperature and salinity on the catch of orangemouth corvina, *Cynoscion xanthulus*. Calif. Dep. Fish and Game, Inland Fish. Adm. Rep. 74–5. 14pp.

———. 1985. The Salton Sea sport fishery. Calif. Dep. Fish and Game, Inland Fish., Reg. 5 Inf. Bul., 0010-5-1985. 43 pp.

Blake, C. and B. F. Blake. 1981. Age determination in six species of fish from a Mexican Pacific coastal lagoon. J. Fish Biol. 18:471–478.

Collins, R. A. 1981. Pacific coast croaker resources. Proc. Annu. Mar. Recreational Fish Symp. 6:41–49.

Freund, R. J. and R. C. Littell. 1981. SAS for linear models, a guide to the ANOVA and GLM procedures. SAS Inst. Inc., Cary, N.C. 231pp.

Howells, R. G. 1990. Preliminary examination of low salinity tolerance of sperm, fertilized eggs, and larvae of orangemouth corvina, *Cynoscion xanthulus*. Calif. Fish and Game 76:58–62.

———. 1991. Identification of orangemouth corvina, spotted seatrout and their hybrids. Texas Parks and Wildl. Dep., Manage. Data Ser. No. 57, Austin. 14pp.

Maciorowski, A. F., R. L. Colura, A. Henderson-Arzapalo, and B. W. Bumguardner. 1986. Spotted seatrout, orangemouth corvina and their hybrids in saltwater pond culture. Texas Parks and Wildl. Dep., Mar. Fish. Cult. Enhancement Proj. F-36-R, Study 4, Segment 1. Texas Parks and Wildl. Dep., Austin.

Marquardt, D. M. 1963. An algorithm for least-squares estimation of non-linear parameters. J. Soc. Industrial and Appl. Math. 11:431–441.

Prentice, J. A. 1985. Orangemouth corvina survival in fresh water. Prog. Fish-Cult. 47:61–63.

——— and R. L. Colura. 1984. Preliminary observations of orangemouth corvina spawn inducement using photoperiod, temperature and salinity cycles. J. World Maricul. Soc. 15:162–171.

———, R. L. Colura, and B. W. Bumguardner. 1989. Observations on induced maturation and spawning of orangemouth corvina. Calif. Fish and Game 75:27–32.

——— and P. Thomas. 1987. Successful spawning of orangemouth corvina following injection with des-Gly^{10}, [D-Ala^{6}]-luteinizing hormone-releasing hormone (1–9) ethylamide and pimozide. Prog. Fish-Cult. 49:66–69.

Procarione, L. S., T. L. King, and B. W. Bumguardner. 1988. Morphometric comparison of fingerling spotted seatrout, orangemouth corvina, and their hybrids. Contrib. Mar. Sci. 30 (Suppl.):21–28.

Texas Parks and Wildlife Department (TPWD). 1989. Texas inland fishery assessment procedures. TPWD looseleaf mimeo. 3-171-06/16/89, Austin.

Warburton, K. 1979. Growth and production of some important species of fish in a Mexican coastal lagoon system. J. Fish Biol. 14:449–464.

Whitney, R. R. 1961. The orangemouth corvina, *Cynoscion xanthulus* Jordan and Gilbert. Pages 165–183 *in* B. W. Walker, ed. The ecology of the Salton Sea, California, in relation to the sportfishery. Calif. Dep. Fish and Game, Fish Bul. No. 113.